

Claims

1 1. A lifting apparatus (20) comprising:
2 one of a mobile and stationary support structure or base (40; 42);
3 a lift platform (30) having a geometric first center(32), the lift platform
4 movable relative to the base from a lowered position to an upper position;
5 a linkage (50) interconnecting the base and the lift platform for guiding
6 the base and the lift platform to stay in a generally mutually parallel
7 relationship as the lift platform moves relative to the base;
8 the base, lift platform and linkage configured so that when the lift
9 platform in its lowered position the first center intersects the base at a first
10 point and with the lift platform in its upper position the first center intersects
11 the base at a longitudinally off-set second point; and
12 lift means, operatively mounted between the lift platform and the base,
13 for controllably lifting and lowering the lift platform.

1 2. The apparatus as defined in Claim 1 wherein the lift means includes a
2 pneumatically inflatable device (60) having a flexible and laterally
3 displaceable side wall(s) (266).

1 3. The apparatus as defined in Claim 1 wherein the lift means includes a
2 pneumatically inflatable device having a laterally displaceable side wall which
3 moves longitudinally in concert with the movement of the lift platform.

1 4. The apparatus as defined in Claim 2 wherein the inflatable device
2 includes a top, having a top center, and a bottom, having a bottom center,
3 wherein when the lift platform is lowered an axis extending through the top
4 and bottom centers is off-set in one direction and with the lift platform in a
5 raised condition the axis is off-set in an opposite longitudinal direction.

1 5. The apparatus as defined in Claim 2 wherein the pneumatically
2 inflatable device includes an inflatable toroidally shaped first member (262a)
3 and an inflatable toroidally shaped second member (262) mounted in fluid
4 communication with the first member.

1 6. The apparatus as defined in Claim 5 wherein the toroidal first and
2 second members are configured so that when they are uninflated the second
3 member fits within the first member and when the members are inflated, the
4 second member is positioned atop the first member.

1 7. The apparatus as defined in Claim 5 wherein a bottom (282) of the first
2 member (262a) is secured to the base (42) and wherein a top (280) of the
3 second member (262) is one of fixedly and slidably secured to the lift platform
4 (30).

1 8. The apparatus as define in Claim 5 wherein an axis which extends
2 through the center of the inflatable second member is coincident with the first
3 center of the lift platform.

1 9. The apparatus as define in Claim 5 wherein an axis which extends
2 through the center of the inflatable first member longitudinally off-set relative
3 to the second point.

1 10. The apparatus as defined in Claim 1 wherein the linkage (50), which
2 guides the lift platform (50) relative to the base, includes a plurality of bars
3 (152-158) each of which are rotatably mounted relative to the base and the lift
4 platform and configured to operate in the manner of a parallelogram linkage.

1 11. The apparatus as defined in Claim 10 wherein
2 a first bar extends from an upper first hinge located near a first end
3 of a first side of the lift platform to a lower first hinge on the base,
4 a second bar extends from an upper second hinge located near a
5 second end of the first side of the lift platform to a lower second hinge on the
6 base.

1 12. The apparatus as defined in Claim 11 wherein the linkage further
2 includes:
3 a third bar extending from an upper third hinge located in
4 between the first end and third end of the lift platform to a lower third hinge on
5 the base, the upper first and third hinges and the lower first and third hinges
6 configured to lie in a predetermined plane.

1 13. The apparatus as defined in Claim 11 wherein the inflatable device is
2 located in between the first and the second bars.

1 14. The apparatus as defined in Claim 11 wherein the inflatable device is
2 located within a spaced defined by the range of movement of the first, second
3 and third bars.

1 15. The apparatus as defined in Claim 12 wherein the linkage further
2 includes:
3 a fourth bar extending from an upper fourth hinge located in between
4 the first end and fourth end of the lift platform to a lower fourth hinge on the
5 base, the upper second and fourth hinges and the lower second and fourth
6 hinges configured to lay in a predetermined plane.

1 16. The apparatus as defined in Claim 12 wherein the linkage further
2 includes:

3 a third bar extending from an upper third hinge, located spaced
4 from an axis joining the first and second upper hinges, to a lower third hinge
5 on the base, the first second and third upper first and third hinges and the
6 lower first and third hinges configured to lay in a predetermined plane.

1 17. A lifting apparatus comprising:

2 one of a mobile and stationary base;

3 a lift platform having a geometric first center, the lift platform movable
4 relative to the base from a lowered position to an upper position;

5 a linkage interconnecting the base and the lift platform for guiding the
6 base and the lift platform to stay in a generally mutually parallel relationship
7 as the lift platform moves relative to the base;

8 a pneumatically inflatable device having a flexible and laterally
9 displaceable side wall, the inflatable device configured so one of its top, side,
10 axis and wall(s) are one of a) off-set in one direction from its bottom with the
11 lift platform lowered and b) off-set in another direction with the lift platform
12 raised straight raised and lowered or offset in either direction raised and
13 lowered.

1 18. The apparatus as defined in Claim 17 wherein the inflatable device
2 operates directly on the platform and the base.

1 19. The apparatus as defined in Claim 17 wherein the pneumatically
2 inflatable device includes an inflatable toroidally shaped first member and an
3 inflatable toroidally shaped second member mounted to the first member.

1 20. The apparatus as defined in Claim 19 wherein the first and second
2 members are configured so that when uninflated, the second member fits
3 within the first member and when the members are inflated, the second
4 member is positioned generally atop the first member.

1 21. The apparatus as defined in Claim 19 wherein a bottom of the first
2 member is secured to the base and wherein a top of the second member is
3 one of fixedly and slidably secured to the lift platform.

1 22. The apparatus as defined in Claim 17 wherein the linkage is configured
2 as a parallelogram linkage.

1 23. The apparatus as defined in Claim 17 wherein the linkage is configured
2 as one of a two, three and four bar parallel configured linkage.

1 24. A lifting apparatus comprising:
2 one of a mobile and stationary base;
3 a lift platform movable relative to the base from a lowered position to
4 an upper position;
5 a linkage interconnecting the base and the lift platform for guiding the
6 base and the lift platform to stay in a generally mutually parallel relationship
7 as the lift platform moves relative to the base;
8 an air spring mechanism mounted below the lift platform and to exert a
9 force thereon to controllably raise and lower the platform, the air spring
10 configured so that the platform is moved vertically by the same amount the air
11 spring height changes.

1 25. The apparatus as defined in Claim 24 wherein the air spring includes a
2 pneumatically inflatable device (60) having a flexible and laterally
3 displaceable side wall(s) (266).

1 26. The apparatus as defined in Claim 24 wherein the air spring means
2 includes a pneumatically inflatable device having a laterally displaceable side
3 wall which moves longitudinally in concert with the movement of the lift
4 platform.

1 27. The apparatus as defined in Claim 25 wherein the air spring device
2 includes a top, having a top center, and a bottom, having a bottom center,
3 wherein when the lift platform is lowered an axis extending through the top
4 and bottom centers is off-set in one direction and with the lift platform in a
5 raised condition the axis is off-set in an opposite longitudinal direction.

1 28. The apparatus as defined in Claim 25 wherein the pneumatically
2 inflatable device includes an inflatable toroidally shaped first member (262a)
3 and an inflatable toroidally shaped second member (262) mounted in fluid
4 communication with the first member.

1 29. The apparatus as defined in Claim 28 wherein the toroidal first and
2 second members are configured so that when they are uninflated the second
3 member fits within the first member and when the members are inflated, the
4 second member is positioned atop the first member.